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F
CONTROL
Suppression

July 25, 1957

Report of Task Force to Recommend Action to Reduce the Chances of Men Being Killed by Burning While Fighting Fire.

USDA FS - auth

Our report and recommendations are attached. We believe that activating these recommendations will go a long way in materially reducing the chances that men will be trapped and burned while fighting forest fires.

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Introduction

This report is submitted in response to the Chief's F-CONTROL Suppression memo of April 25, 1957. By that memo, the Chief appointed a task force to study ways the Forest Service may strengthen its efforts to prevent fire fatalities.

Objectives. The task force was given these definite assignments:

1. Recommend further action needed in both administration and research to materially reduce the chances of men being killed by burning while fighting fire.

2. Recommend ways to develop experts in fire behavior.

Since this study has been purposely centered on fire fatalities by burning, we have not reviewed general safety practices nor injuries due to causes other than burning. However, carrying out the recommendations made in this report will probably be very beneficial in improving the general level of safety practice in fire suppression.

Procedure. We reviewed pertinent material that could be made available on the casualty-causing fires of the past 20 years. We interviewed in Washington and in the field some 30 Forest Service employees and former employees representing six regions and several stations. One of our members interviewed qualified spokesmen from the California State Division of Forestry and from the Los Angeles County Fire Department. We also solicited suggestions from Forest Service regions and experiment stations. Ideas from these several sources were catalogued, combined, and fully discussed by the task force.

The Problem of Tragedy Fires

According to available records, since 1936 there have been 16 tragedy fires on the national forests in which 79 men lost their lives by burning. Such fires occurred in 11 of the twenty years, and in seven regions. Eight of these fires involved the death of more than one man. All of the fires became of Class E size before control, although all were not Class E at the time the men were burned. The Southern California forests, in spite of their reputation for bad fires, have had only 5 of these fires, on which 26 men died. Tragedy fires occurred in all months from July through November. There was also one in May.

Well documented and complete records are available for some but not all of these tragedy fires. The task force reviewed the records that are available, looking for threads that run through all, or most, of them. From what we could deduce, there are two factors which were common to all the fires reviewed. These were: (1) fuels which burned

in a flashy manner even though some would not ordinarily be typed as flash fuels; and (2) a period of critical fire danger at the time and place of the occurrence that resulted in injury, although the general fire danger was not always critical. A third factor appeared to be present on all but one of the fires. That was fire behavior which was not expected by the men who were trapped.

On several of the fires, the possibility of unusual fire behavior was anticipated by someone on the fire, someone not connected directly with the affected crew. While every fire was a fast-moving fire at the time of the accident, not all of the fuels would normally be classed as flashy fuels.

There are a large number of factors that were common to many but not all of the fires. Any analysis now is limited by suitability of records. Based on a searching hind-sight look, we have grouped under eleven captions the factors which seemed to us to be critical.

Designation as "critical" does not mean that there was negligence, nor necessarily that there were failures in these specific items. These items represent, in our judgment, the areas of action in the management of these fires in which sub-par performance, or absence of exceptional performance, may have resulted in some action which subsequent events showed to have been of a "critical" nature. They are, therefore, the areas of action which should be high-lighted in determining what can be done to strengthen performance in assuring safety of fire fighters on the fire line.

The factors are as follows:

1. Unexpected fire behavior -

   Basic elements not understood; indicators of change in usual fire behavior not recognized; local fire-weather forecasts not obtained, inaccurate or not understood.

2. Instructions -

   Not followed, not clear, or not given.

3. Foremanship -

   Lost control of men at critical time.

4. Line supervision -

   Overhead busy on minor jobs, not available when major decisions had to be made.

5. Communication -

   Not available, not used, or broke down.

6. Fire fighting strategy and tactics -

Control effort made in wrong location or without adequate margin for safety; detailed line location incorrect.

7. Scouting -

Not done, not thorough, too dependent on air scouting.

8. Escape plan -

Not formulated, not explained, not executed.

9. Lookout posting -

Routine practice not followed.

10. Organization -

Men and machines committed to action without adequate supervision, or without adequate tie to rest of organization.

11. Post-injury actions -

Delayed first aid; search for injured delayed or not thorough; rescue facilities inadequate.

For each of the five major tragedy fires, (eleven or more men killed), we consider that at least seven out of the eleven groupings were critical. On all five fires, items 1, 2, 5 and 8 were critical. With the exception of number 11, all items were critical on at least 3 fires.

Item 11 is difficult to appraise. Probably the rescue facilities were inadequate on every fire. We have shown this as "Critical" on only two fires since we conclude that on the other three post-injury actions were prompt and were made with facilities that were adequate for the state of medical knowledge of that year.

Most of these items were also of importance on the fires which happened to kill a smaller number of men. For the fires in this group, the records, or else the stage of action on the fire, were such that direct comparisons item by item are not feasible, or else not significant.

By way of comparison, we also reviewed several well-documented "near miss" incidents. It was very apparent that the non-occurrence of a tragedy achieved in these "near miss" situations came about because performance was at or above normal expectations in one or more of these critical categories. Instructions were carried out, the foreman retained control of the crew, the escape plan was executed, or some cool head sized up a local change in fire behavior and figured out what would happen in time to get men to safety.

Conclusions

There are several significant things about the preceding list. Many of these items represent sins of omission which our trained men recognize as sins. Many of these items appear time and again in the summaries of fire boards of review on non-tragedy fires. Except for some of the fire behavior topics, the items on this list are covered to some extent in the fire overhead training which most regions used to give. We are not certain that all regions now give consistent training to fire overhead personnel which would cover all these items.

It is apparent to us that efforts to reduce fatalities must be aimed at: More effective organization, more assurance that good fire fighting practices will be used under all circumstances, better foremanship, better functioning of all segments of a fire suppression organization, better strategy and tactics based on confident anticipation of fire behavior made available currently at the scene of the fire and more expert interpretation of these forecasts. In short, we will probably have less casualties as we do a better and more effective job of managing the suppression of a fire. Our recommendations are aimed at improved performance in these categories of major need.

Any measures that will reduce fire occurrence, or increase the proportion that are controlled as small fires, will work toward the same end. Efforts to improve performance in these respects should be vigorously continued. But the Forest Service must be prepared to deal effectively with the small percentage of fires that become big and burn as a fast-moving fire in almost any fuel type.

In order to keep the spotlight focused on major needs, we have purposely limited our recommendations to the major areas we believe must have attention. We have not tried to incorporate here all the excellent suggestions received, many of which deal with important details. These will be turned over to the Division of Fire Control.

Action Required

We visualize that to materially improve the effectiveness of managing suppression of large fires it will be necessary to do ALL of the following things:

1. Standardize Service-wide practice regarding suppression organization, procedure, and terminology. Other phases of fire control probably should be brought under standard practice too.

2. Assure acceptable training in these standardized practices by using Service-wide courses for training crew bosses and also for training other categories of fire control overhead. Couple the training courses with a standardized Service-wide system of fire overhead qualification ratings based on training and experience and supported by tests and rating cards. Safe practices in fire fighting would be an integral part of this training.

3. Meet the special problem of training men in fire behavior by establishing a Service-wide Fire Control Training Center to train fire behavior specialists, to give centralized, intensive training for fire bosses, and, as necessary, to train regional fire control officers as fire overhead trainers. Direction of all fire training activities should, in due course, come from this unit.

4. Get existing knowledge of fire behavior written up in form suitable for wide-spread field use, and press for expanded research in fire behavior. If necessary to secure results, these needs should be given priority over other phases of the fire research program.

Recommendations

The recommendations have been divided into two parts. Part A consists of items which are suitable for immediate action and should be put into effect during the 1957 fire season. In Part B are included actions for which some additional time or preparations will be needed, either plans, or assignment of men, or fitting some items into future budget requests.

A. Items that are suitable for immediate action.

1. Adherence to "Principles of Organization".

Recommendation:

Require, effective immediately, adherence in all regions to the pattern of organization for fire suppression set forth in the 1953 publication titled "Principles of Organization for Fighting Forest Fires".

Interforest and interregional details of fire overhead continue to be a necessary part of the way we fight fire. It is possible to have lack of clear understanding by men from different units as to the meaning of terms, the duties of various fire overhead positions, acceptable ratio of fire overhead to fire fighters and machines, and the accepted relationship between segments of the fire organization. Failure to apply these organizational principles was a factor in some of the recent tragedy fires we reviewed.

2. Crew Boss Training in Blow-up Conditions.

Recommendation:

Conduct Service-wide training courses for crew bosses in safe practices under blow-up conditions, using the training outline which the task force has submitted to the Division of Fire Control. This training should be given by the regions and forests to all men likely to be used as crew bosses during the remainder of the 1957 fire season.

Review Boards for the tragedy fires have consistently emphasized the need for greatly strengthened training of fire fighting personnel in fire behavior and related fire action. A permanent program of training in this and related subjects is covered in a separate recommendation. There is, however, a step that can be taken as an interim measure.

Region 6 has prepared a training outline entitled "Safe Practices Under Blow-up Conditions for Crew Bosses". For a starter, on a

Service-wide basis, this outline does an acceptable job of covering the general subject. With some changes which we have made it is suitable for use by all of the regions for putting on a training course adapted to regional conditions. Each region should arrange that training in this subject be given the men who are most likely to serve as fire crew bosses.

3. Standard Fire Fighting Orders.

Recommendation:

Adopt for Service-wide use the attached "Standard Fire Fighting Orders". These orders to be committed to memory by all personnel with fire control responsibilities.

Military organizations have had long experience in training men to remember certain fundamental instructions and to react even in emergencies in accordance with those instructions. One device by which such discipline is achieved is that of "General Orders", which all men of the unit are required to memorize. On some of the fires that we reviewed, men who know better just did not pay adequate attention to good fire fighting practices that seem like small details but could become the critical item in an emergency. The use of a form of standard orders starting immediately would be a long step in the direction of assuring attention to the fundamentals.

4. Communication on Campaign Fires.

Recommendation:

Give increased attention to communication on campaign fires, including exploring the use of transistor-type receivers, and encouraging the practice that receivers on all radios used on a fire line on a campaign fire be "on" at all times.

One of the threads that runs through the action on most of the tragedy fires (and also on fires that merely got big) is breakdown of plans for communication on the line, or inadequacy of such communication. In some cases, the breakdown may involve not having communication facilities in use during a critical period of five minutes or less. This subject requires continuing attention, but there are things that can be done now to emphasize this critical item. At least one region follows a practice that radios issued to fireline personnel on campaign fires have the receivers "on" until the sets are returned to camp. All administrative units could go at least this far.

Additional Points the Task Force Believes Should Be Emphasized.

The preceding four recommendations comprise items that can be made immediate targets of Service-wide action required by the Chief's office. There are four additional points which should be emphasized this year. The emphasis on these points will have to come from the regions, in their training efforts.

a. Proper line location.

For the overhead on a fast-moving fire, this topic involves one of the very critical decisions affecting safety of men and spread of the fire. This is a decision which should be made by the most qualified overhead available, usually a man of not less than division-boss caliber. If a control line cannot be placed right on the edge of a fire, the line should be located a sufficient distance from the fire edge to provide a margin of safety for the men and to allow adequate time for the line to be constructed and burned out before the main fire reaches it. This decision must consider possible changes in burning conditions and the fatigue factor of the men.

b. Interregional fire details for training fire overhead.

This existing policy needs a shot-in-the-arm. Some regions have not had campaign fires in recent years. Those regions are short of men with recent experience in handling large, fast-moving wild fires. They will get it only by going as trainees to such fires in other regions.

c. Use of daily time schedules in coordinating plans and action on campaign fires.

A frequent cause of sloppy fire suppression action is the matter of delays resulting from decisions not made in time. An effective way to assure the making of decisions on time is for the fire boss to prepare a simple time table and insist that it be followed. This time table would include the time by which major strategy decisions must be made for each shift in order to allow time for coordination with action on other sectors, preparation of instructions, crew travel time, etc., and to permit top overhead to coordinate their actions and to get needed rest.

d. Use of local qualified men as fire behavior advisors to the fire boss.

Review Boards of the last three tragedy fires emphasize the need to do much more in bringing existing fire behavior knowledge to bear in planning control action of fast fires in bad fuels. The full answer to this need requires long-term action. But there is one thing that can be started now.

There are a number of highly experienced fire fighters who have accumulated for their home locality comprehensive knowledge of fire behavior. Much might be gained by using such men in a capacity as advisor to the fire boss.

B. Items that will require additional time or preparatory work.

1. Standardization of Practices.

a. Standardization of Fire Control Organization.

Recommendation:

Fully standardize Forest Service practice regarding fire suppression organization, procedure and terminology in all regions, and keep it standardized.

There can be no room in a heads-up fire fighting organization for anything but the best fire fighting practices. Historically, the regions have developed their own organization methods and have assimilated practices from other regions only slowly. Even strong pushing from the Chief's office has sometimes failed to persuade some regions to apply a "best" practice if it is someone else's. During developmental years, independent searching for methods is highly desirable. But later on there comes a time when the best practices must be pulled together and the whole organization incorporate those "best" ways as standard procedure. The 1953 publication of "Principles of Organization For Fighting Forest Fires" and the 1956 edition of "Glossary of Terms Used In Forest Fire Control" were long steps in this needed direction.

It seems probable that future years will see ever greater dependence on fire overhead detailed from forest to forest, and from region to region. Improved air transportation makes this increasingly feasible. Localized terminology and forms of organization can only be sources of confusion. This will be especially true as mechanization of the fire suppression job increases.

If the Service is to successfully carry on the massive increase in training effort which it must do, there can be only one fire fighting system in which men are trained. That must be the Forest Service system. The Service cannot afford misunderstandings about meaning of terms, patterns of organization, duties of various jobs, and other fundamentals of fire management.

Mandatory adherence to "Principles of Organizing For Fighting Forest Fires" and "Glossary of Terms Used in Fire Control" should be required in all regions. The Division of Fire Control should also take active leadership in determining other action phases of fire control, such as pre-suppression, that should be standardized on a Service-wide basis, and in seeing to it that standardization works. That Division will also need to give continuing attention to the way new findings are handled and are fitted into the standard Forest Service fire fighting system.

b. Standardization of Fire Danger Rating Methods.

Recommendation:

Establish uniform methods of rating fire danger in all regions.

In all of the disaster fires reviewed by the task force, burning conditions were either unusually severe or such low fuel moistures existed that only a change in wind was needed to make the fire situation extremely critical. In many areas, bad fire days occur so infrequently that the major part of the experience gained by our fire control people is on fires occurring at times of easy to moderate burning conditions. The task force believes that lack of information and experience in the potential of fire under extreme burning conditions is an important contributing factor in fire deaths . Some quantitative measure that will accurately indicate the relative seriousness of any set of burning conditions is essential to safe and effective fire control. This is one of the chief purposes of fire danger rating.

At present there are several danger-rating systems in use by the Forest Service. Each system integrates the effects of weather, fuels, and other burning factors on the control job in a different way. Thus it is possible for the same set of burning conditions to be evaluated differently depending on the system used. It is also possible for men new to a region and unfamiliar with its system to be seriously misled through inability to correctly appraise the significance of ratings given by the local system.

None of the fire disasters reviewed can be directly attributed to the confusion created by different danger-rating systems. The situation is potentially dangerous because of the increasing interregional use of fire control men and the increasing use of fire danger rating in all phases of fire control. The task force has concluded that steps to standardize fire danger rating within the Forest Service should be taken as soon as possible.

Development of standard methods of rating fire danger is a joint responsibility of Forest Administration and Fire Research. It is recognized that the job is extremely complex because of widely varying fuel and weather conditions and the different ways danger rating is put to use. It was agreed at the National Fire Research Conference in Missoula in 1955, however, that standardization of fire danger rating is technically possible and feasible.

The task force estimates the cost of developing uniform danger-rating methods at about $150,000. The job will require 3 to 4 years to complete.

2. Fire Control Training

a. Training for crew bosses and other fire overhead.

Recommendation:

Establish a system of qualifying men for fire overhead ratings based on standardized training and qualifying experience appropriate for the level of responsibility to be assumed.

There are no standardized training outlines to cover fire overhead positions. Most forests give training for fire crew bosses. The pattern of training for other fire overhead varies widely from region to region, and also from forest to forest.

With standardized practice in fire suppression, as covered in Recommendation 1a, it will be feasible to have standardized training for the various fire overhead jobs for Service-wide use. It will also be possible to set up a reasonably uniform system of qualifying men for the various levels of fire overhead responsibility, based on successful completion of training courses plus successful completion of qualifying experience.

The task force believes that, as a minimum, Fire Control should prepare standardized training outlines and training material for (1) crew bosses, and (2) all other fire overhead. The regions should train their own men, using the standard outlines and training material. Fire Control should also prepare a schedule of training and experience considered necessary for men to qualify as: (1) crew boss, (2) sector boss, (3) division boss, (4) fire boss, and (5) other categories such as line boss, service chief and plans chief. Based on this schedule, the regions should then administer a program of qualifying individuals for various fire overhead positions, using rating cards issued to individuals as they qualify. Special attention must be given to the qualifications needed for men to be used in inter-regional assignments. Many of the features of this recommendation are now used by individual regions.

Fire Control also should spark the preparation of training aids for giving the standard courses and inspect for results in the quality of training given.

It would be very desirable to have this system well under way in time for the first guard training camps in 1958.

b. A training Center.

Recommendation:

Establish a Service-wide Fire Control Training Center.

The purpose of this Center is primarily to provide a high level of training for fire behavior specialists, and a nucleus of fire bosses. This is training which requires special facilities and instructors, and which cannot be given as training on the job. The Center will be concerned directly with the training of (1) fire behavior specialists; (2) fire bosses (after training they would be called fire suppression specialists); and (3) instructors for other fire control personnel. The Center will also develop the necessary courses and training aids needed by these instructors.

The need for training fire behavior specialists is now widely recognized. This must be a highly specialized type of training, given only to men who have some special aptitudes. There are two choices, (1) either contrive university training at existing schools regardless of how long it may take for each man, or (2) determine precisely the training that is needed and make special arrangements for selected men to get it in the shortest practical time. The task force concludes that the latter course represents the best answer. The special training needed can be best arranged in a central location that has access to university facilities and instructors. Part of the instruction would also have to be given by Forest Service fire behavior experts. A statement on the instruction that must be included is given in the appendix.

If the Forest Service is to do a more effective job of fire suppression management, there must also be high level fire generalship training for the men concerned with this management, the fire bosses. Since they should have the best training possible in fundamentals of fire behavior, a logical arrangement would be for fire boss trainees to receive training in fire behavior from our own experts in conjunction with the training to be given the fire behavior men. Training for fire bosses should also include fire suppression organization, maintaining command under emergency conditions, drill in organization relationships, study of past campaign fires, and field practice on prescribed burns, slash fires, etc.

We believe each region should have a nucleus of trained fire bosses who can take over the tough, big fires with appropriate help from the local forest forces. The Forest Service is already beyond the time when it can afford the luxury of planning that every ranger will always be the fire boss on his own district. The first men picked to receive fire

training should be younger men already experienced as fire bosses.

Regional Office fire control staff officers should also receive the training as fire bosses. They should also be trained as instructors so that they can sparkplug in their region the crew boss and fire overhead training covered by Recommendation 2a. This instructor training should be a function of the Center.

The following plan and time schedule is suggested to get the Center under way:

First Step. Select two qualified Forest Service men, one from Administration and one from Research, to work with representatives of the Division of Fire Control and the Division of Fire Research on: (1) selection of sites for in-service training, university instruction, and field problems; (2) method of selecting trainees; (3) development of a curriculum; (4) preparation of instruction material; (5) arrangements with a major university, perhaps on a contract basis, for specialized courses in subjects relative to fire behavior; (6) arrangements for in-service instructors; and (7) preparation of a financial plan and program details as required. This step will require about 15 months.

Second Step. Start the Center with the first group of trainees. Correlation with classes at the university, in-service training, and field projects including slash burning, prescribed and controlled burning, and actual fires will have to be worked out in detail.

It is estimated that it will require from 7 to 9 months intensive training for the fire behavior specialists and approximately 3 months for the fire bosses. One additional month should be planned to qualify those specialists who will serve as instructors for regional training programs.

The first group of fire behavior specialists should be limited to 5 trainees. The second and subsequent groups perhaps could be increased to 10 trainees. The fire bosses should be trained in groups of 10. It is felt that 5 fire behavior specialists and 20 fire suppression specialists could be trained the first year the Center is in operation.

The program should be continued until at least 25 fire behavior specialists and 60 fire bosses have been trained under the centralized training system. After this number has been trained, the program should be reanalyzed and the number needed on a permanent basis determined.

Estimated finances for the Center by years are as follows:
(These figures include salary and expenses for the trainees)

First Step - $25,000 - For salary and expenses of the two in-service men selected to establish the Center.

Second Step - Training 5 fire behavior specialists.

University courses	-	$ 4,400
Regular salary and expenses - Trainees	-	40,000
Proportionate share of in-service instructors, training materials, and Center operating expenses	-	10,000
Sub-Total		$54,400

Training 20 fire bosses.

University courses	-	$ 1,100
Regular Salary and Expenses-Trainees		66,000
Proportionate share of in-service instructors, training materials, and Center operating expenses		10,000
Sub-Total		$77,100
Total through Second Step	-	$131,500

Subsequent years in which the Center would train at least 10 fire behavior specialists and 20 fire bosses would cost approximately $185,900 annually, including the salaries and expenses of the trainees.

3. Fire Research

a. Fire Behavior Research

Recommendation:

Assemble and compile existing knowledge of fire behavior, and prepare from it material for lesson plans and training aids; press for an expanded program in fire behavior research.

Action is needed on the following 3 items:

1. Existing knowledge of fire behavior must be assembled and compiled. Most of the information from formal research is now in the heads of comparatively few men. This information must be assembled and put into form so that it can be made available to fire fighting personnel. The responsibility for assembling the fire behavior information is primarily that of fire research. High priority should be assigned to this task.

2. Fire Research and Fire Control will then need to put together for field use lesson plans, training aids, etc.,

that utilize the information from No. 1 above on fire behavior. This need is essential in order to have material available for the massive increase in training effort recommended in item 2a. Fire Research and Fire Control have joint responsibility to get this job done.

3. The Forest Service as a whole must press for an expanded and balanced program of fire behavior research that can make realistic progress in providing badly needed quantitative fire behavior information.

Items 1 and 2 are essential, but by themselves they are seriously inadequate. Item 3 is a "must" because present research effort in this field is not great enough.

All the written reviews on tragedy fires commented on the urgent need for more and better information about fire behavior. We acknowledge the need for other fire research too, such as research in fire control and fire prevention. It is fire behavior research, however, that offers the greatest chance of providing results that will prevent deaths by burning. Quantitative information is needed that will answer such questions as:

> What changes can be expected to occur in rate of spread, direction of spread, intensity of burning, crowning, and spotting in the next few minutes? this planning period? next planning period? What sequence of changes can be expected in this work shift? next work shift? What does the fire weather forecast mean in changes in fire behavior in different sections of the fireline? What are the critical time limits for direct attack? Backfiring? Danger to men? Where are the danger spots? Places of safety? How hot will the fire burn? How large a safety spot is needed? What action can be taken to counteract unwanted fire behavior?

These are only a few of the many questions concerning fire behavior that must be considered in making decisions and planning action on wildland fires. Men's lives depend upon the correct answers and actions.

The various phases of fire behavior research, such as fuel studies, fire weather studies, combustion processes, etc., are so interdependent that for the present at least comparatively little progress can be made in applying results in one phase without new work in, or new information from, another. For example, it is of comparatively little value to know that a roll eddy will develop on the lee side of a ridge with certain wind and topography unless it also is known whether the eddy will affect the fire and, if so, how. Likewise, information on effect of fuel arrangement or fire intensity is of limited usefulness unless there is some practical means of identifying and classifying fuel arrangement in the field. Fire behavior research must, therefore, progress as a whole balanced program in order to make a significant contribution to better fire control and saving lives on the fire line.

b. Operations Research

Recommendation:

Make an operations research study of the entire problem of organizing for fire suppression.

One way to minimize the risk involved in fire suppression is to make sure the fire suppression organization we use is the best one to get the job done. Application of the operations research technique to this problem offers the most promise of providing the best solution possible.

An essential characteristic of operations research is that it seeks to find the optimum decision, policy or design and not merely a better solution to the one in use. Limitations in funds, time, or scientific information may prevent finding the best solution but operations research is always aimed at getting as close to the optimum as possible.

Another important characteristic of operations research is its "team" approach to the problem. The research is carried out by scientists drawn from different scientific and engineering disciplines. A major reason for these teams is to bring the most advanced scientific procedures to bear on the problem or to develop new procedures if necessary. The idea is that no one mind can hold all of the potentially useful scientific information--but the combined minds of the team may.

We believe that the operations research approach holds much promise and that an operations research study of the entire problem of organizing for fire suppression could pay big dividends over the long pull. At least initially, this work should be headed up in Fire Control Research, whether done by our own research people, or by contractors or consultants. We believe that this work should not be undertaken until it can be financed from additional funds, since funds now available are urgently needed for work in fire behavior and immediately related research.

4. Other Items Needing Special Attention.

a. Fire Weather Forecasting

Recommendation:

Make a special point of continuing to work closely with the Weather Bureau to improve fire weather forecasting services.

To the fire boss, predictions of fire weather are as important as predictions of fire behavior. A specialist in fire behavior cannot function as an advisor to a fire boss without access to fire weather forecasts. A strenuous effort to improve our management

of large fires would contain a void if the fire weather forecasting phase should be overlooked.

The Forest Service must keep working with the Weather Bureau to obtain appropriate recognition of fire weather forecasting problems and needs. These Weather Bureau needs include: Personnel problems of recruitment, training, and career development; adequate financing for the number of mobile units or special fire weather forecasters required by our estimates of fire needs; continuing research in techniques; and no doubt others.

Since the Forest Service is a principal customer for fire weather forecasting services, the Service must impress the Weather Bureau with the importance of those services, and be as helpful as possible to that agency in solving problems it encounters in improving fire weather forecasting service.

b. Career Development

Recommendation:

Make a determined effort to improve career possibilities for non-technically trained fire control personnel; secure greater recognition of professional aspects of fire control in academic training.

Career limitations in the present fire control aid series result in the loss of well qualified fire men to woods and other industries, state and county protection agencies, and other jobs where better careers are available. This situation makes it difficult to recruit and develop additional suitable men in this category. There is "in-service" competition in that better careers are available in the timber management jobs of the forestry aid series. The men involved in these positions are the people who provide the local experience and stability which is important in the fire control job.

The Division of Personnel Management is now planning a program which will extend development of classification standards for fire control personnel to higher grades. The task force endorses this plan and recommends that thorough study and full consideration be given to the complexities of the fire control job when establishing these standards.

Training in the field of fire control receives comparatively minor attention in the technical education of a forester. Better recognition by educational institutions of the professional aspects of the fire control job should result in more basic knowledge for the forester in this field. There are many complications of text development, curriculum, instructor availability, and cooperative work with forestry schools involved in accomplishing this objective. The task force urges the Divisions of Personnel Management and Fire Control to focus

attention on this subject and to work with the forestry schools toward the development of more nearly adequate instruction in fire control.

c. Pre-planning for fire suppression.

Recommendation:

Encourage a more active program in (1) pre-planning for fire suppression and (2) breaking up large unbroken areas of hazardous fuels.

Study of the fire casualty cases showsthat virtually all of the deaths from burning occurred on large (Class E) fires in unbroken fuel types. The task force is greatly impressed with work being done in several parts of the country in pre-planning for fire suppression and in the use of physical changes or cover manipulation to break up large unbroken areas of fast-burning fuel types. We believe that greater activity in these lines should be encouraged especially in changing vegetative cover through normal resource management activities.

d. Safety Gear Development.

Recommendation:

Maintain a continuing project of investigating protective gear for fire fighters, and arrange tests for any promising equipment.

A number of suggestions on this subject sent to the task force appear to merit investigation.

Any program undertaken in this field would undoubtedly involve research to determine temperature and oxygen supply conditions. If such research indicates reasonable possibilities that men may survive normal fire conditions when equipped with suitable protective gear, further testing and development of these devices would be highly desirable.

We believe the regular equipment development procedures can and should be used for this purpose.

e. Near Misses

Recommendation:

Encourage field units to write up "near miss" situations as a basis for continued training in how to save men's lives on the fire line.

Forest Service fire fighting history is full of "near miss" situations. There were occasions in every region and in many years when the elements for a tragedy were present but men did not get trapped. There is unique training value in the review of such a situation provided enough of the surrounding circumstances are known and recorded to permit later informed discussion of what happened. Too often these occasions are not written up at all, or are written up in a superficial way so that it is not possible at a later date to reconstruct all the significant happenings. Hence the training value is lost.

The task force has seen several write-ups that are sufficiently complete to be used as a lesson plan in a training session for fire overhead. Region Seven did an especially good job on a 1953 fire on the George Washington National Forest. This write-up appears as a Region Seven Handbook supplement.

Fire Control should urge more of this, through the editorial facilities of "Fire Control Notes" if necessary to get material prepared with adequate coverage.

Impact Of These Recommendations

The task force members appreciate that these recommendations will have an impact on the present organization and budget. We had hoped to develop a program that could be carried out entirely within the limits of the present budget. We cannot in conscience do so. The recommendations grouped in Part A above, and which were submitted to the Staff in advance of the rest of the report, can be carried out entirely within the limits of existing manpower and funds. The recommendations grouped in Part B above will require men, or money, or preparatory work on someone's part before they can be put into effect. Unless otherwise specified, that "someone" is probably the Division of Fire Control in Washington.

Our recommendations on training and on research will cost more money than can easily be wrung from the present budget. Recommendation 2a, Training for Crew Bosses and Other Fire Overhead, can be carried out by the present organization pattern, including use of detailers. So can Parts 1 and 2 of Recommendation 3a, provided Fire Research can shuffle current work assignments so as to free from all other work the men who are competent to write up existing knowledge of fire behavior. But the task force feels that the Service would be taking only stop gap measures if only these limited parts of Recommendations 2 and 3 are carried out.

So, what about the added costs? We see the approximately $190,000 a year for training for 5 years or so, and the larger sums needed especially for fire behavior research, as an integral part of what the Service must pay to handle this hazardous and tricky part of its business. Even now, the Service does not spend much money for the sole purpose of being prepared to handle campaign fires. For years it has been acknowledged that the campaign fires are the costly ones, and the ones that do the heavy damages. It is not uncommon to have a half million dollar bill for the fighting of one campaign fire.

There is also another kind of impact. The program we recommend must have strong leadership at the Washington office level. To standardize fire control practice requires firm leadership concerning the standards to be followed, and the general instructions which field units must follow. This can be done without limiting the authority of field units to make the command decisions that must be made in the field. It cannot be done without strong leadership in Washington.

This is more than just more men. It is also a matter of attitude, on the part of Fire Control and Fire Research, and on the part of all the individuals who influence the work in these two divisions.

We feel it is essential that there be more men working in these two divisions at the level of Washington office leadership, or else that those now there have adequate time for the creative thinking and problem-solving which must occur if there is to be strong leadership.

We appreciate that these impacts are serious. We feel that they must be faced.

The Problem of Pressures to Fight Fire in Disadvantageous Places.

Throughout our deliberations it has been difficult to draw the line between actions aimed at greater safety to men and actions which are desirable to just improve fire fighting effectiveness. In talking about future problems it is especially difficult to draw this line. But we clearly see one changing condition which is filled with serious potential for increased hazard to the lives of men who fight fire. Consequently we believe that a brief discussion of this problem is justified in this report, even though we pass over the problems of greatly expanded use of air-craft, greatly increased striking power for initial attack forces, and similar matters which clearly are major problems of the future in improving fire fighting effectiveness.

Lands protected by the Forest Service are becoming more and more valuable for the products and services they produce. More homes, other structures, and communities are being built within or near national forest boundaries. There are steady increases in the privately-owned values in and adjacent to the national forests which are subject to damage by fires spreading from national forests, or by flood and erosion damage originating on burned areas within national forest protection boundaries. With these changes have come increasingly greater pressures to protect improvements in place and to keep damage low by keeping fires small.

Typical of this problem are the fires that burned on county-protected land around Malibu in southern California last winter. In the early action on these fires the county-directed crews had to give first priority to saving lives and property, with second priority attention given to controlling the spread of the fire. There are places now within national forests where Service suppression forces would have to do the same thing, even though such action would mean attacking fires in situations not most advantageous for control. Such action can be exceptionally hazardous for the safety of the fire fighters.

Although this situation is critical now in relatively few areas, the problem will become of increasingly greater concern to the Forest Service. As the population increases and all resources become more valuable, the pressures to keep fires small or fight them at disadvantageous places will become greater and greater. The potential for tragedy fires hence will also increase. The task force believes that this special problem must be recognized in some special ways.

This problem has many ramifications which we did not analyze. There is need to identify the individual localities where the Service might find it necessary to fight fire under disadvantageous circumstances either to protect structures or because of other very high values. For those localities and circumstances there is need to determine the relative responsibility of the Forest Service for all or part of the

fire protection action that may be needed. And there is need to plan action that will be taken under varying sets of circumstances.

To provide adequate fire protection in some places may eventually require the degree of specialization and professionalism in wild land fire control that urban fire departments now have. To attack fires in adverse situations and still maintain a reasonable margin of safety for men requires knowledge of fire behavior far beyond that now available. Highly skilled overhead with well disciplined crews intensively trained in proper fire fighting techniques and equipped with most modern equipment will be essential. New ways to increase the striking power of control crews must be found. There is also a prominent place for more intensive suppression preplanning.

Underlining the importance of this special fire control problem is last winter's Supreme Court decision on the Forks Fire of 1951. It seems probable that most major fires that affect private values in any way will become a basis for damage claims alleging negligence. This threat of liability claims against the United States under the Tort Claims Act makes it all the more important that the Forest Service take all practical precautionary measures to be fully prepared both in special problem areas and also in general fire fighting organization and practice.

The task force believes that, as a minimum, each region should identify the areas where special suppression problems of the type here discussed are critical now and should give them special planning attention.

ITEMS IN APPENDIX

1. List of Tragedy Fires of the Last Twenty Years.

2. Analysis of Principal Factors Common to the Five Major Tragedy Fires.

3. General Scope of Instruction to be given Fire Behavior Specialist Trainees.

4. Suggested Draft of "Standard Fire Fighting Orders".

5. Suggested Training Outline for 1957 Training of Crew Bosses in Blow-Up Conditions. (W.O. File Copy Only).

6. Copies of the Chief's F-Control-Suppression Memoranda of March 11, 1957 and April 25, 1957.

APPENDIX

Table 1.

List of Tragedy Fires of the Last Twenty Years.

Name of Fire	Date	Region	Forest	No. Fatalities by burning
Inaja	1956	5	Cleveland	11
East Highlands	1956	5	San Bernardino	1
Sagebrush	1955	6	Malheur	1
Johnson	1955	3	Prescott	1
Tunnel No. 6	1954	5	Tahoe	3
Rattlesnake	1953	5	Mendocino	15
Mann Gulch	1949	1	Helena	13
Hells Canyon	1949	4	Payette	1
Walton Spur	1949	5	Stanislaus	1
Barrett Dam	1948	5	Cleveland	1
Bryant Canyon	1947	5	Cleveland	2
Hot Springs	1944	4	Payette	1
Hauser Creek	1943	5	Cleveland	11
Silver Plume	1940	3	Lincoln	1
Blackwater	1937	2	Shoshone	15
Welcome Lake	1937	9	Huron	1

APPENDIX

Table 2.

Analysis of Principal Factors Common to the Five Major Tragedy Fires.

(This table is the basis for the discussion on page 4 of the report.)

	Major Factor	Fire				
		Inaja	Rattle-snake	Mann Gulch	Hauser Creek	Black-water
		R-5	R-5	R-1	R-5	R-2
1.	Fire Behavior	C	C	C	C	C
2.	Instructions	C	C	C	C	C
3.	Foremanship	NC	C	C	C	NC
4.	Line Supervision	C	C	NC	C	NC
5.	Communication	C	C	C	C	C
6.	Strategy & Tactics	C	NC	C	C	C
7.	Scouting	C	NC	-	C	C
8.	Escape Plan	C	C	C	C	C
9.	Lookouts	C	C	-	C	NC
10.	Organization	C	NC	C	C	C
11.	Post Actions	NC	NC	C	C?	NC

C - Critical

NC - Not Critical

"-" - Not pertinent

APPENDIX

Item 3

Scope of Instruction to be given Fire Behavior Specialist Trainees.

Prepared by Clive Countryman

The way in which a fire burns is in response to the interaction of the fire and its environment according to natural physical laws of combustion and thermodynamics. Because both fire and environment are dynamic it is necessary to know how and why the environment will change, in addition to its interaction with fire, in order to understand and predict fire behavior. Much of the training of the fire behavior specialist must hence be devoted to understanding the fundamental factors affecting fire environment, combustion, and their interaction.

Selection of Trainees: The training given the fire behavior specialist must be highly specialized and should be given only to men with an aptitude and desire for this type of work. It is recommended that a committee be set up to pass on the suitability of each candidate for this training. Suggested minimum requirements are:

1. Several years of active fire line experience.
2. Not over 35 years of age.
3. A B.S. degree.
4. Natural interest and inclination to fire control.
5. Demonstrated ability to learn and accept new ideas.
6. Demonstrated ability to quickly and accurately size up a complex situation and arrive at definite and logical conclusions.
7. Ability to act decisively.
8. Ability to think in abstract as well as concrete terms.

It is probable that aptitude tests can be developed for selection of men to be given training as fire behavior specialists.

Curricula: Details of the curricula for this training should be worked out by representatives of the Division of Fire Control and the Division of Fire Research in consultation with subject matter specialists. The subject matter of each course should be designed for the training of fire behavior specialists -- standard college courses cover a broader field than is necessary for fire behavior training. The following subjects should be covered.

Academic Studies.

1. Review of mathematics, physics, chemistry and statistical methods.

2. Meteorology.

   a. Climatology -- Elementary course.

   b. Dynamic and Synoptic Meteorology: - Sufficient training in dynamics and synoptic meteorology should be given so that the trainee will have a thorough working knowledge of the fundamental causes of weather and how and why it can be expected to vary. Standard text books can supply the material for this course.

   c. Micrometeorology: - Micrometeorological studies will be concerned with variations of the weather in the layer of the air close to the ground -- the weather most affecting the fire. Text book material such as Gerger's "Climate of the Air Near the Ground" supplemented with information from fire research can supply the basic material for this course.

3. Thermodynamics.

   The purpose of this course is to provide a working knowledge of the fundamentals of heat and heat transfer. The course should be limited to applied thermodynamics and can be developed from standard text books.

4. Fire and Fire Behavior.

   This course will include studies of the combustion processes -- weather factors, fuels, topography, multiple ignitions, area ignition, etc. Material for this course will have to be developed from research results, experience and theory.

Laboratory and Field Studies.

Classroom studies should be supplemented with demonstrations in the laboratory and in the field. Whenever possible provision should be made for active participation of the trainee, on a limited scale, in research projects concerned with fire behavior and environment. The final period of training should be conducted in the field under actual field conditions. Prescribed burns, brush control burns and slash burning should provide ample opportunity for training in application of the principles of fire behavior.

Period of Training: - It is estimated that the fire behavior specialist training course would require 7 to 9 months of intensive work.

APPENDIX

Item 4

STANDARD FIRE FIGHTING ORDERS

1. FIRE WEATHER. Keep informed of fire weather conditions and predictions.

2. INSTRUCTIONS. Know exactly what my instructions are and follow them at all times.

3. RIGHT THINGS FIRST. Identify the key points of my assignment and take action in order of priority.

4. ESCAPE PLAN. Have an escape plan in mind and direct subordinates in event of a blow-up.

5. SCOUTING. Thoroughly scout the fire areas for which I am responsible.

6. COMMUNICATION. Establish and maintain regular communication with adjoining forces, subordinates, and superior officers.

7. ALERTNESS. Quickly recognize changed conditions and immediately revise plans to handle.

8. LOOKOUT. Post a lookout for every possibly dangerous situation.

9. DISCIPLINE. Establish and maintain control of all men under my supervision and at all times know where they are and what they are doing.

10. SUPERVISION. Be sure men I commit to any fire job have clear instructions and adequate overhead.

Item 6.

COPY

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

Washington 25, D. C.

F
CONTROL
Suppression
Inaja Fire

March 11, 1957

Regional Foresters
and Directors

Dear Sir:

Eleven fire fighters were killed by the Inaja Fire on the Cleveland National Forest in November 1956. Three of these were Forest Service officers. The fire action and events which preceded this tragedy were investigated by a team of Forest Service men with wide experience in fire control. A report on the tragedy was prepared from this team's findings. We are sending you under separate cover this report with an appendix containing extra material and pictures, in sufficient amount to supply district rangers and other Forest Service officers who have fire control responsibilities. We want to be certain that the lessons learned from this fire are widely known and fully utilized in preventing similar disasters.

The recommendations in the report have my approval and full support. Our knowledge of fire behavior has increased in recent years but a stronger research program is needed. Development work in aerial attack on fires will be greatly stepped up this year with the new T.B.M. planes. While these planes are stationed in California they will be available for use elsewhere. Our helitack program being done in cooperation with other agencies is providing some new and improved techniques for the use of helicopters on fires. Experts in fire behavior are urgently needed and must be developed. I am asking our Division of Personnel Management to devote special attention to the problem of recruiting and keeping competent fire personnel. Work on the classification problems is already underway.

The investigators did not have sufficient time to analyze the details of our fire work and make specific suggestions. They believed that a task force of experienced fire control people should be appointed to do this job. This is a good suggestion and I plan to appoint a special group soon. I will ask that they analyze our present policies, objectives, fire organization structure, instructions and procedures in fire control. I will want them to particularly examine our current training and safety programs. They will be expected to make specific recommendations on how to develop the necessary experts in fire behavior. We will be writing you further about this task force at an early date. We also will write you further on the general subject of training and safety.

(Over)

2-Regional Foresters and Directors-3/11/57

This report and the information sent with it should be used to the maximum within each Region in training and safety work. The loss of life is a serious thing to all of us in the Forest Service. We must make it the job of everyone to apply practices and procedures and to follow techniques that we know will lessen the chances of such disasters.

I am expecting that you will give this matter your personal attention so that it will receive proper attention in work plans and at other appropriate times and places.

Very truly yours,

/s/ Richard E. McArdle

RICHARD E. McARDLE, Chief

Item 6

COPY

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

F
CONTROL
Suppression

Washington 25, D. C.

Regional Foresters
and Directors

April 25, 1957

Dear Sir:

My letter of March 11 notified you that a task force would be organized to study how we might strengthen our ways and means of preventing fire fighting fatalities. Members selected to serve are:

Art Greeley, Regional Forester, R-9 (Chairman)
L. K. Mays, Chief, Division of Operation, R-8
Clive Countryman, Div. of Fire Research, California Station
Veldon A. Parker, Forest Supervisor, Lassen National Forest, R-5
W. R. Moore, District Ranger, Lolo National Forest, R-1.

This task force will study the service-wide problem of preventing fire fatalities and will recommend further action needed in both administration and research to materially reduce the chances of men being killed fighting fires. The study is deliberately focused on death by fire rather than on the other causes of fire fatalities.

The task force will meet in the Washington office May 6. At that time they will prepare, in consultation with Washington office staff members, a detailed plan for carrying out this assignment. C. K. Lyman of the Division of Fire Control is designated as W.O. liaison to assist the task force. We expect work to proceed expeditiously in order that action can be initiated this fire season on as many of the recommendations as possible. The first session of the committee should not take more than one week. The plan of work will be made at that time. We would then expect Countryman, Parker and Moore to gather information and do the necessary staff work for further deliberations of the committee. The full committee will meet again to complete their report late in May or early June.

I realize this is a busy time of the year for all of these men, but the work of this group is vital. This office will finance the travel and per diem costs for the men on this project.

Very truly yours,

/s/ Richard E. McArdle

RICHARD E. McARDLE, Chief

Appendix 8